

A Study of Road Accidents Cause by Human Error

Introduction

Transportation plays a key role in the development of any country. It facilitates the movement of goods and people, promotes trade, supports industrialization, and helps integrate different regions economically and socially. In a large and diverse country like India, transportation systems represent the lifeblood of economic activity that helps bridge the urban-rural divide and substantially contributes to GDP growth. Amongst various means of transportation, road transportation dominate in term of usage and infrastructure investment.

Road transport, has grown rapidly, especially after the liberalization of the Indian economy in the 1990s. With over 6.3 million kilometres of road network, which is the second largest in the world, roadways offer unparalleled flexibility, accessibility, and reach. Road transport is the preferred mode for short and medium distances, last-mile connectivity, and door-to-door delivery services. Buses, trucks, cars, and two-wheelers dominate the road transport sector, and it is one of the most substantial contributors to employment and logistics across urban and rural India.

Accidents on the road are among the leading cause of death worldwide and primarily takes place in the age group of 15 to 49 years. During the calendar year 2023, road crashes in India accounted for about 1.73 lakh lives and caused injuries to 4.63 lakh persons. Road Accidents being the result of inter-play of many factors, multi-pronged measures are needed to reduce the number of accidents and fatalities. Therefore, the Ministry of Road Transport and Highways has initiated an active policy approach towards road safety by incorporating active participation of all the stakeholders across the country.

In most of the cases road accident are caused by human error. Road safety is a shared responsibility. Decreasing the risk of road traffic systems requires commitment and informed decision-making by government, industry, NGOs, professionals and communities, through a broad range of cooperative activities and interventions including enforcement of legislation to control speed and alcohol consumption, mandating the use of seat-belts and crash helmets, safer design and use of roads and vehicles, and public education on road safety. Very few studies have attempted to understand the epidemiology of risk factors associated with RTA in Indian cities. The main objective of conducting this research was to understand the main cause behind the large statistics pointing towards the most major cause of road accidents and understanding the impact it has on the people along with prescribing preventive measures for the same.

Literature review

Lot of researchers have done research work in the area of road traffic accidents. Few of them have analysed accident data in various ways such as, identification of black spot regions, atmospheric conditions, vehicle conditions, driver mood, roadwork etc. while, some of them have developed accident models for forecasting future accident trends and they have also suggested plan of action for road safety.

Meshram & Goliya 2013 were introduced an analysis of accidents on small portion of NH-3 from Indore to Dhamnod. The data for analysis is collected for the period of 2009 to September 2011. Mostly accidents occurred in Manpur region by damaged road geometry. The trend of accidents occurring in urban region (Indore) is more than 35 % to rate of total accidents in annually. This may due to high speeds and more hauler traffic. In the recent study area, the frequency of causing death accidents is 2 in a week and 6 for minor accidents in a week. greater number of accidents observed in 6 p.m. to 8 p.m. (tare, Bhatore, H.S.Goliya, & Meshram, 2013)time span because in that time more buses are travels between villages and city. One fatal and five casualties are occurring per km per year in the study area. The volume of the trucks passing through study corridor is increasing by year. At Rajendra Nagar from 2000 onwards the traffic is reduced due to the construction of by passes in that area. Shruthi et al., 2013 approached her study regarding the road accidents in south Indian metropolitan cities in different dimensions. She has been examined the injury and mortality pattern of the autopsy cases to draw public attention and to create awareness among the public for accident-free transportation.

Goel & Sachdeva 2014 shows study on National Highway-1 at Delhi to Ambala to Amritsar Road. The road was divided into small parts 5 km of each and the data for road accidents over the past four years 2007 to 2010 was study to identify the accident-prone zones and the study resulted that the extend between 140-144 km is the risk prone zone to frequent accidents. Theofilatos & Yannis 2014 was introduced “a review of the effect of traffic and weather features on road safety”. Despite the existence of generally mixed proof on the effect of traffic boundary, a few patterns can be observed. For instance, traffic flow seems to have a indirect relationship with accident rates, even though few studies suggest direct relationship with accidents. On weather effects, the effect of precipitation is rather consistent and leads in general to increased accident frequency, but does not appear to have a compatible effect on severity. The effect of other weather parameters on safety such as clarity, wind speed and temperature are not found straightforward so far. The increasing use of real-time data not only makes simple to identify the safety effect of traffic and weather characteristics, but most importantly makes possible the identification of their cumulative effect. The more systematic use of these real-time data may address several of the research gaps identified in this research.

Kumar & Bansal (2016) conducted a study regarding the analysis of road accident in Hisar district at state of Haryana. The main objective of the study was to identify the

framework behind road accidents, areas where accidents occur continuing in Hisar Sirsa road and Hisar Delhi bye-pass. The study had suggested policy enhancement such as traffic management, modifying of acceleration, and deceleration tracks were suggested.

Du et al., (2020) conducted a study on basic precautions of road traffic accident-related traumatic brain injuries in adolescent populations that is a systematic review of helmet legislation. The researcher has mentioned that road traffic accidents are the most frequent cause of severe traumatic brain injury (TBI), particularly among youth populations worldwide. Helmets are proven to prevent wound; however, estimates of helmet compliance are low globally. The study resulted that helmet legislation is connected with increased helmet use among bicyclists and decreased road traffic accidents related head injuries and victim among motorcyclists and bicyclists.

The literature review showcases the major cause of road accidents as rather human effort and traffic rule violations which have been further studied in the paper along with the suggestion of preventive measures and its impacts on the lives of the victims and their families.

Objectives of the Study

- 1.To identify the main cause leading to road accidents.
2. To analyze the effect of road accidents caused by human error on individuals and society.
3. To suggest possible solutions and preventive measures for the reduction of road accidents caused by human error.

Methodology

This is a qualitative research project aimed at analysing the causes of road accidents and ascertaining the best preventive measures that can be taken against them. The qualitative approach is suited to investigate the complex social, infrastructural, and environmental factors that contribute to accidents, focusing on detailed contextual understanding rather than numerical generalisation.

Study Area

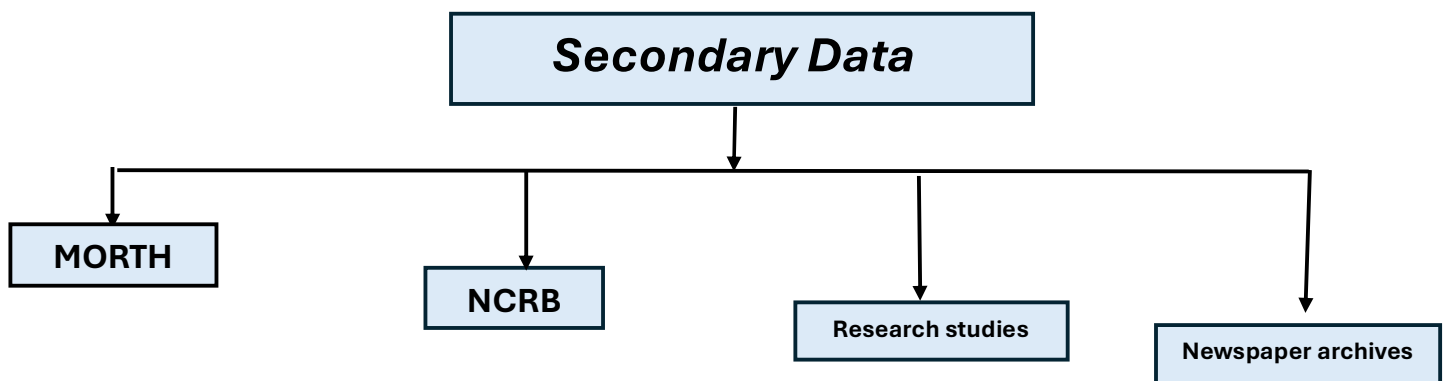
The study area is selected, namely Delhi, the capital of India which faces a high intensity of vehicular traffic along with frequent road accidents. The area selected has diverse road types, starting from urban streets to highways and residential zones, which will be highly suitable for examining multiple accident-related conditions like traffic congestion, poor road maintenance, and inadequate safety measures.

Data Collection Methods

Field observations, document analysis, and case studies will form the basis of this study. Accident-prone locations will be observed to capture important elements such as road design, traffic flow, signage, lighting conditions, pedestrian behaviour, and enforcement practices. These observations would endeavour to identify apparent risk factors for road accidents. Secondary data will be obtained from official reports of ministry of road transport and highways, national crime records bureau, Delhi transport department, records of traffic police, research studies, and newspaper archives. These documents can help understand the contextual accident trends, policy responses, and existing safety initiatives in the area under study.

Case Study Approach

Central to the study is the case study method. The study area will be divided into several zones, with specific accident-prone zones or "black spots" to be selected for detailed examination. Each case will be analysed in terms of road conditions, environmental features, traffic density, and recurring patterns of accidents. Such case studies will be compared in order to identify causes that are location-specific and generalisable so that targeted preventive measures can be formulated.



Findings

1. Road accidents are multi-causal phenomenon and are the result of an interaction of numerous factors. These can broadly be categorized into (i) human error, (ii) road conditions and (iii) vehicular condition. These factors act in a collaborative way of causing accidents on the roads.

Any approach for designing the counter measures for accidents may therefore be based on a safe systems approach which simultaneously acknowledges the necessity of traffic legislation and its enforcement for Promote education on safe road users behaviour. Engineering of vehicles and roads Along with emergency care may also play an important role in road safety.

HUMAN ERROR

TRAFFIC RULES VIOLATIONS

Road accidents attributable to various types of traffic rules violations, it appears that 'over speeding' is the principal infringement associated with accidents, fatalities and injuries, in 2023. During 2023 'over speeding' accounted for 68.4% of the total road accidents, 68.1% of total deaths and 69.2% of the total injuries. The number of accidents, fatalities and injuries due to "over speeding" fell by 1.4%, 1.9% and 0.7%, respectively, in 2023 compared to 2022 (Table 1.1). The 'others' category which would include reasons such as road environment, vehicular condition, etc., was the second highest cause of the total road accidents during 2023 account for 22.5 %. The study however mostly focuses on the human error aspect of road accidents.

Data analysis took into consideration a total number of accident involvements of 686,0 during the 1-year period among these about 1,602 severe accidents (i.e., an accident with at least one injury) and 5,258 PDO accidents the frequency of at-fault drivers involved in these two types of traffic accidents. An about 46.5% of the drivers involved in at least one PDO accident against 1.15% involved in at least one severe accident. The average rate accident involvement per driver is 0.968 accidents during one years. It is mean about 193 accidents per 1000 driver in a year and 2.4 severe accidents per 1000 driver in a year.

Total number of violation involvements of 2867 are included in the analysis. Among these, about 19 violations are considered as hazard violation class based on AD traffic police classifications. Hazard violation list includes about 25 types of violations out of 173 violations listed in the traffic law in AD. The 25 hazard violations include for example aggressive driving, exceed the limit speed by 60kph or more, read light crossing, sudden lane changing, tailgating, alcohol usage and mobile usage during driving, etc. The recorded violation indicates that the violation rate in a year is 3.989 and about 0.798 violation per driver in a year. In addition, violation rate of the hazard violation class is 1.373 violations per driver over years and 0.275 violations per driver in a year.

Table 3.1: Road Accidents by Type of Traffic Rules Violation during 2023

Category	2022			2023			% Change in 2023 over 2022		
	Accidents	Fatalities	Injured	Accidents	Fatalities	Injured	Accidents	Fatalities	Injured
Over-speeding	3,33,323	1,19,904	3,22,795	3,28,727	1,17,682	3,20,416	-1.38	-1.85	-0.74
% share of total	72.26	71.16	72.81	68.4	68.07	69.23			
Drunken driving/consumption of alcohol & drug	10,080	4,201	8,809	9,143	3,674	8,421	-9.3	-12.54	-4.4
% share of total	2.19	2.49	1.99	1.9	2.13	1.82			
Driving on wrong side/Lane indiscipline	22,586	9,094	21,745	25,242	9,432	24,435	11.76	3.72	12.37
% share of total	4.9	5.4	4.9	5.25	5.46	5.28			
Jumping red light	4,021	1,462	3,450	2,440	818	2,157	-39.32	-44.05	-37.48
% share of total	0.87	0.87	0.78	0.51	0.47	0.47			
Use of mobile phone	7,558	3,395	6,255	7,122	2,884	6,445	-5.77	-15.05	3.04
% share of total	1.64	2.01	1.41	1.48	1.67	1.39			
Others	83,744	30,435	80,312	1,07,909	38,400	1,00,951	28.86	26.17	25.7
% share of total	18.15	18.06	18.11	22.45	22.21	21.81			
All India	4,61,312	1,68,491	4,43,366	4,80,583	1,72,890	4,62,825	4.18	2.61	4.39

TABLE 1.1

Source : Ministry of road transport and highways transport research wing

Result and discussion

The main motive of the study is to present an analysis and overview of the road accidents in India.

Impact of Road Accidents on Families

Road accidents in India are not only a public safety concern but also a social and economic tragedy that has affected countless families. According to the latest Road Accident Report, 2023, from the Ministry of Road Transport and Highways, 4,80,583 road accidents resulted in 1,72,890 deaths and 4,62,825 injuries across the country. Of these, the majority of victims belonged to the working-age group of 18–60 years, accounting for 83.4% of total fatalities, meaning that the breadwinners of every family are the most impacted, thereby leaving dependents at the mercy of financial distress. Many families lose their livelihood in an instance, which, in the case of rural or poor households, ultimately propels them into poverty.

The economic consequences are not limited to immediate medical expenses; they include loss of future income, rehabilitation costs, and accumulation of debt from loans taken for hospital treatment. Many families of victims remain under debt burden for many years after an accident. The psychological impact is equally serious: Long-term trauma, anxiety, and depression among family members arise from sudden death or disability of

a family member. Loss of parental guidance deprives children of education, and surviving spouses suffer social and emotional isolation. Victims who survive with disabilities have to depend on others throughout their lives in some cases. At the national level, this results in a huge loss of productivity and human capital, weakening the economy as a result.

At-Fault Drivers and Human Error in India

Human error remains the leading cause of road accidents in India, responsible for the majority of crashes and fatalities. According to the MoRTH 2023 data, over-speeding remains the major contributor, accounting for 68.4% of total accidents and 68.07% of fatalities. This shows that reckless driving habits are deeply ingrained among drivers. Driving on the wrong side or lane indiscipline accounted for 25,242 accidents and 9,432 deaths, while drunken driving resulted in 9,143 accidents and 3,674 deaths. Mobile phone use while driving led to 7,122 accidents and 2,884 fatalities. The numbers clearly show how distraction and negligence directly lead to fatal outcomes.

Three-quarters of road deaths happen because of the fault of the driver—a confirmation that most are preventable if proper care is taken. Moreover, non-compliance with safety measures increases the severity of accidents. According to a report by The Print (2024), a total of 16,025 died in 2023 because they were not wearing seat belts—8,441 were drivers, and 7,584 were passengers. Similarly, thousands of two-wheeler riders die every year due to the absence of helmets. These numbers expose serious disregard for road safety norms.

Driver faults arise mainly from risk-taking behavior, fatigue, poor training, lack of awareness, and overconfidence. A commercial vehicle driver puts in long hours of work, with hardly any rest, and hence is more prone to errors due to fatigue. Poor licensing enforcement and slack traffic regulation are also contributing factors to bad driving habits. Thus, driver behavior assumes prime importance in bringing down accident numbers.

Preventive Measures and Solutions to Reduce Human Error

Multi-dimensional strategies involving enforcement, education, technology, and behavioural reform are needed to prevent accidents caused by human error. To begin with, strict enforcement of traffic rules is necessary. The law enforcement agencies should employ the latest technologies like speed cameras, ANPR systems, and breath analysers to detect violations. Over-speeding, drunk driving, and use of mobile phones while driving should attract heavy fines and suspension of driving licenses.

Second, awareness and education are crucial. Road safety campaigns under the National Road Safety Policy must be enhanced to increase people's knowledge regarding the risks of rash and distracted driving. Introduction of road safety education in schools and colleges will inculcate a sense of safe driving among youngsters. For the existing

drivers, defensive driving training programs along with periodic re-certification tests will help improve driving behavior and skills.

Thirdly, accidents can be reduced substantially by technological solutions. All vehicles should be fitted with Advanced Driver Assistance Systems (ADAS), automatic braking systems, and lane departure warning systems. Commercial vehicles can be tracked to keep in check the speed limit using GPS and telematics devices. Infrastructure modifications like improving lighting of roads, putting speed breakers in accident-prone zones, and enhancing signage will go a long way in minimizing driver-related risks.

Furthermore, the use of seat belts and helmets needs to be socialized through enforcement and public education. Campaigns need to emphasize how simple safety actions save lives. Driver fatigue management, including mandatory rest hours for long-distance drivers, is also necessary.

Finally, government and institutional support should be offered to all families affected by road accidents through schemes for compensation, rehabilitation, and counseling. Support for the families of victims reduces the long-term social cost of accidents and helps reinforce a culture of accountability and empathy.

Conclusion

The majority of road accidents in India are caused by human error, especially over-speeding, drunk driving, or distracted driving by at-fault drivers. The human and economic toll such tragedy inflicts on families can leave them financially broken and emotionally scarred. Such tragedies need to be averted not only with more strict law enforcement but also by transforming the driving culture with education, technology, and social responsibility. Safer roads will save lives, preserve families, and strengthen the nation's social and economic fabric.

References

- goel, g. (2014). identification of accident prone location using accident severity value on selected stretch of NH-1. *international journal of engineering research and applications*.
- Kakkar, R., Aggarwal, P., Kakkar, M., & Deshpande, K. (2014). Road Traffic Accident: Retrospective Study. *Indian Journal of Science Research*, 59-62.
- kumar, s., & bansal, v. k. (2016). A GIS based methodology for safe site selection of a building in a hilly region. *frontiers of architectural research* , 39-51.
- pirjade, s. (2023). rail transportation vs road transportation- a comparison on feasibility. *L.N.Welingkar institute of management development and research*.
- pirjade, s. (n.d.). rail transportation vs road transportation. *L.N+*.
- (2023). *road accident in india* . new delhi: government of india.
- Singh, S. K. (2017). Road Traffic Accidents in India: Issues and Challenges . *Transportation Research Procedia*, 4708-4719.
- tare, v., Bhatore, A., H.S.Goliya, & Meshram, K. (2013). Pavement Deterioration modeling for low volume roads. *journal of the indian road congress volume 73-4*.
- tiwari, g., goal, r., & bhalla, k. (2023). *road safety in india: status report 2023*. delhi: transportation research and injury prevention centre indian institute of technology delhi.